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17 *Attorneys for Defendants*

18   UNITED STATES DISTRICT COURT

19   NORTHERN DISTRICT OF CALIFORNIA

                              OAKLAND DIVISION
20

21 REARDEN LLC et al.,	Case Nos. 4:17-cv-04006-JST
Plaintiffs,	4:17-cv-04191-JST
22 vs.	**DECLARATION OF VINCENT CIRELLI**
23 THE WALT DISNEY COMPANY et al.,	**IN SUPPORT OF DEFENDANTS'**
Defendants,	**MOTIONS FOR SUMMARY JUDGMENT**
24 REARDEN LLC et al.,	**ON CAUSAL NEXUS ISSUE**
25 Plaintiffs,	Judge: Hon. Jon S. Tigar
	Date: To be set
26 vs.	Time: To be set
27 TWENTIETH CENTURY FOX FILM CORPORATION et al.,	Ctrm.: 6 (2nd Floor)
28 Defendants.	

DECLARATION OF VINCENT CIRELLI

1 I, Vincent Cirelli, hereby declare:

2   1.   I am a senior visual effects supervisor at Luma Pictures ("Luma"). Luma was hired as a

3 visual special effects vendor for the movies *Guardians of the Galaxy* and *Avengers: Age of Ultron*;

4 I supervised Luma's work for those movies, including work on the character of Thanos in each of

5 the movies. I have personal knowledge of the contents of this declaration. If called as a witness in

6 this action, I could and would testify competently to the contents of this declaration.

7   2.   I understand that Plaintiffs' claims in the above-captioned case relate to facial motion

8 capture work in connection with the character "Thanos" in *Guardians of the Galaxy* and *Avengers:*

9 *Age of Ultron*.

10   3.   I supervised the creation of the Thanos character for those movies. The creation of the

11 Thanos character used facial motion capture data from the visual effects studio DD3. My

12 understanding is that DD3 used the MOVA system to assist with capturing and processing this

13 facial motion capture data. Luma's process for creating the Thanos character for *Guardians of the*

14 *Galaxy* and *Avengers: Age of Ultron* was as follows:

15   4.   We received facial motion capture data from DD3 containing data about the movement of

16 the actor's (Josh Brolin) face excluding areas around the eyes and the lips. An image of a tracked

17 mesh with facial capture data points appears below. We compiled a full library of the actor's

18 facial expressions in the tracked mesh.

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5.   We separately created a 3D model of the Thanos character, called a "rig" or "target rig." The Thanos rig was created entirely from scratch by digital artists and animators at Luma. The Thanos rig was developed to perform a range of facial expressions; every facial expression in the library of Thanos rigs was likewise handsculpted by digital artists or animators. The following three images show (a) a set of Thanos rigs performing a variety of facial expressions; (b) a close-up Thanos rig with a neutral facial expression; and (c) a close-up Thanos rig with a different facial expression. Each of these images depicts the target rig before the use of any MOVA data. At this point the Thanos rig could be further hand animated to create dialogue if needed, and pushed through the pipeline to create a photoreal Thanos.
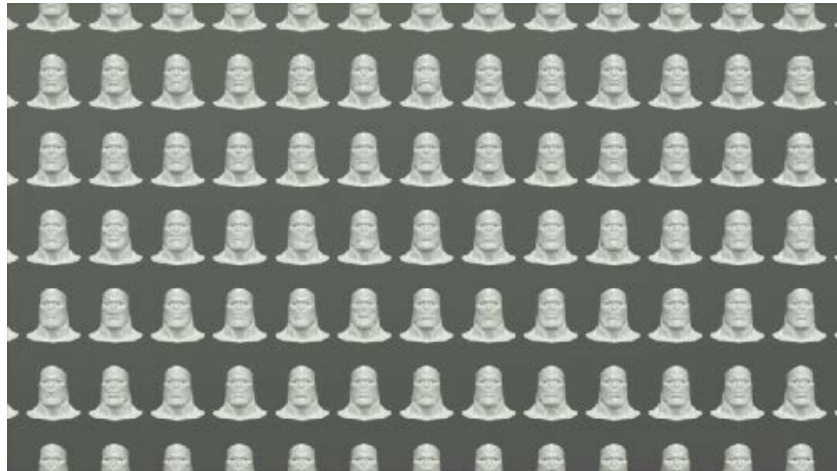
6.   Our programmers developed a proprietary software called Face2Face, which made it possible to analyze the point movement of the MOVA-derived tracked mesh data, deriving a formula of how facial shapes contribute to the MOVA data, which then allows us to better understand timing and shapes to trigger in the Thanos rig. Even for those expressions that were based on the MOVA-captured performance processed through Face2Face, every line of the

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performance was either retargeted, replaced or accentuated by hand by our animators to create the creature known as Thanos. This is due to the performance needing to be embellished to characterize an aesthetic of the imaginary creature, and also because the proportions of Thanos and the human face are very different. In addition, the original data from DD3 omits information about eyelids, eyes, and the mouth—arguably the most expressive components of any character performance. Accordingly, for MOVA-captured expressions, animators had to hand-sculpt the eyes and lip regions of the facial expressions.

7.   We initially experimented with mapping the tracked mesh directly onto the Thanos rig, without further processing through Face2Face. This was unworkable and failed to produce usable facial motion. In fact, this direct mapping produced facial motion that was memorable only because it was amusing.

8.   After facial motion was successfully built into the Thanos rig, substantial further effort by animators and digital artists was necessary to develop the facial rig into the final deliverable to the studio.

a.   We had to model Thanos's face to add skin color, texture, shading, and other details. These details were manually designed and added to the Thanos rig, and required substantial artistic and manual effort. For example, we used hand-painted computer-generated textures using the software MARI to provide texture to Thanos's skin, as well as his metal armor. The purple color of Thanos's skin was a particular challenge and required substantial testing to perfect. The images below are (a) a sample from the process of layering hand-painted textures onto Thanos's face using the Mari software;

and (b) a sample from the process of modeling facial hair (*i.e.*, stubble) onto Thanos's face:

b.   We also developed additional tools in simulation to add the movement of the skin across the surface of the face, as well as blood scattering, wrinkles, and other types of movement. We used software called nCloth to simulate the consistency of skin, and understand how it moves and slides on the face. Luma developed proprietary scripts running inside MAYA to simulate blood scattering. Animators then worked to further refine and perfect the skin movement. The image below is a sample from the process of refining the movement of Thanos's facial skin by hand:

c.   Our final deliverable to the studio production team was the rendered character combined with the entire scene, so we were also responsible for rendering the character. Rendering is a complex process to transform the 3D computer file of the character into a 2D image that can be depicted onscreen. It can be very time-consuming, and involves understanding such subtle details as how the light falls on the scene. The images below are (a) a sample from the process of perfecting the light reflected on Thanos's face; and (b) four sample images that show a few of the different visualizations of the Thanos face that are involved in the rendering process:

DECLARATION OF VINCENT CIRELLI

9. The following image depicts Thanos's face as it ultimately appeared onscreen in a Luma-created shot.

10. The facial motion capture data Luma received from DD3 is a starting point—giving certain cues to our animators and digital artists for some facial movement, timing, and cues in the underlying performance—but its usefulness ends there. For instance, picking up from the point where DD3 provided the MOVA-captured data for *Guardians of the Galaxy*, nearly 60 Luma artists and supervisors were involved in creating the Thanos shots, logging nearly 4,000 hours working specifically on the Thanos character, and over 7,000 more hours on lighting and compositing Thanos and the other elements in the shots. In my experience, the lion's share of time spent on lighting and compositing are focused on the character, especially in this situation given the Thanos character's significance in those scenes.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct and that I executed this declaration this __28__ day of February, 2019 at Los Angeles, California.

Vincent Cirelli